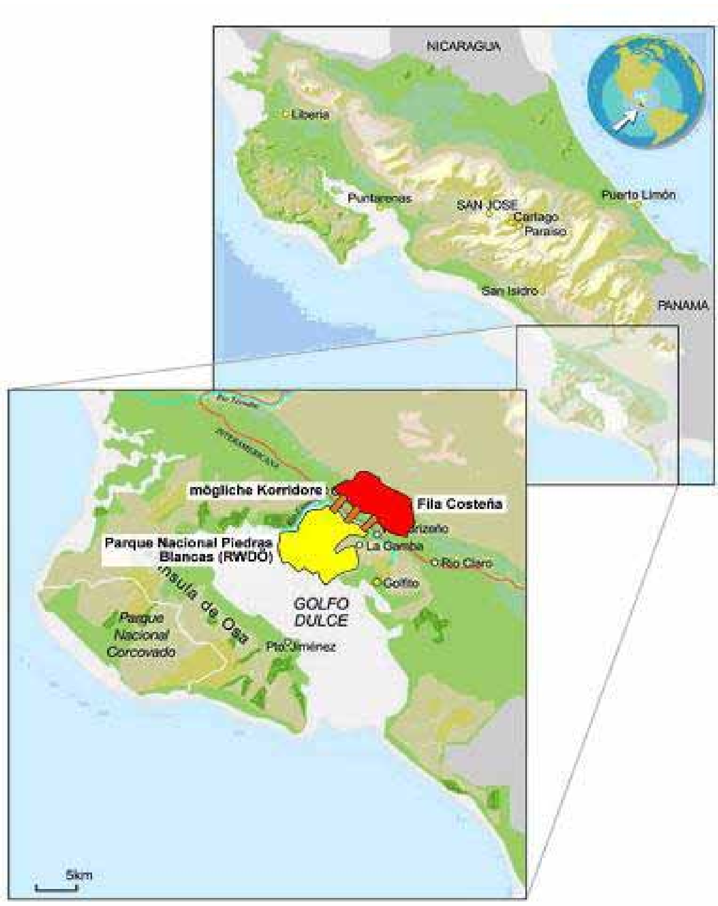
Project Description

COBIGA: Biological Corridor La Gamba, Costa Rica

Project Goal

COBIGA aims to make an important contribution to reducing current climate change brought on by the greenhouse gas CO_2 and its long-term integration into biomass, while at the same time, in the long run, conserving the biodiversity of the area comprising the Rainforest of the Austrians and the Golfo Dulce region. By reforesting with more than 150 tree species, the project attempts to re-create and simulate a primary forest as well as possible. The reforestation will be scientifically accompanied to include issues such as CO_2 accumulation, growth rates, suitability of tree species and biodiversity conservation. Simultaneously, still existing "forest islands", which are threatened by logging, will be protected by purchasing the endangered land.



The Rainforest of the Austrians

The 159 km ² Esquinas Rainforest in southwestern Costa Rica is one of the last remaining lowland rainforests on the Pacific coast of Central America and is one of the most species-rich forests on earth. Until 1991, the forest was wholly owned by about 140 private owners from the surrounding villages, who had permits to cut the valuable hardwood trees. To stop the deforestation, the Costa Rican government declared the area as Piedras Blancas National Park in 1991. However, lacking the means to buy the endangered land and thus protect the area forever, it was dependent on international financial aid in the implementation of its exemplary environmental plans.

During in the past 25 years, the non-profit association Rainforest of Austrians, founded by Prof. Michael Schnitzler, has purchased over 4000 hectares of this paradise, which have been donated to the National Park Administration of Costa Rica. Thousands of Austrians, including children from more than 300 schools, have donated almost $5 million. The land was incorporated into Piedras Blancas National Park. In the meantime logging has been prohibited, 72% of the area is under the protection of the National Park Administration, and the remaining land is no longer in danger. Michael Schnitzler was awarded the Austrian State Prize for the Environment (Konrad Lorenz Prize) for his efforts.

Rainforest of the Austrians, together with the Tropical Station La Gamba, has been supporting project the COBIGA (Biological Corridor La Gamba) since 2012 and was able to acquire and partially reforest almost 300 hectares of land. In addition, since 2003, the association has been paying the salaries of gamekeepers and providing financial support to projects for endangered species.

www.regenwald.at

La Gamba Tropical Field Station

The Tropical Station La Gamba is a research and educational institution of the University of Vienna situated on the edge of the Rainforest of the Austrians. Located in one of the most species-rich lowland rainforests in Central America, it offers ideal conditions for field research, courses and seminars. It provides infrastructure for hosting student and research groups through teaching and project internships, field trips and research activities, as well as scientific workshops. The station attaches great importance to working closely with the people of La Gamba. Social projects and events support the concerns and needs of the population.

The tropical station makes a significant contribution to the study of tropical rainforests, raises interest in the conservation and research of the rainforest and offers students and nature lovers the opportunity to deepen their understanding of nature by experiencing the surrounding rainforest. Projects dealing with the reforestation of former forest areas and the connection of exisiting, isolated forest areas (corridor project COBIGA) are among the most important goals of the station, besides the support of research and teaching. More than 150 master, bachelor and doctoral theses and numerous publications have dealt with the rainforests surrounding the tropical station.

To enable the operation of the world‘s only Austrian tropical research station, and to secure an economic basis for the survival of the station, the Association for the Promotion of the Tropical Station La Gamba was founded. The necessary funds are raised through membership fees, donations and sponsorship from private hands as well as additional funding from public funds.

www.lagamba.at

Baseline

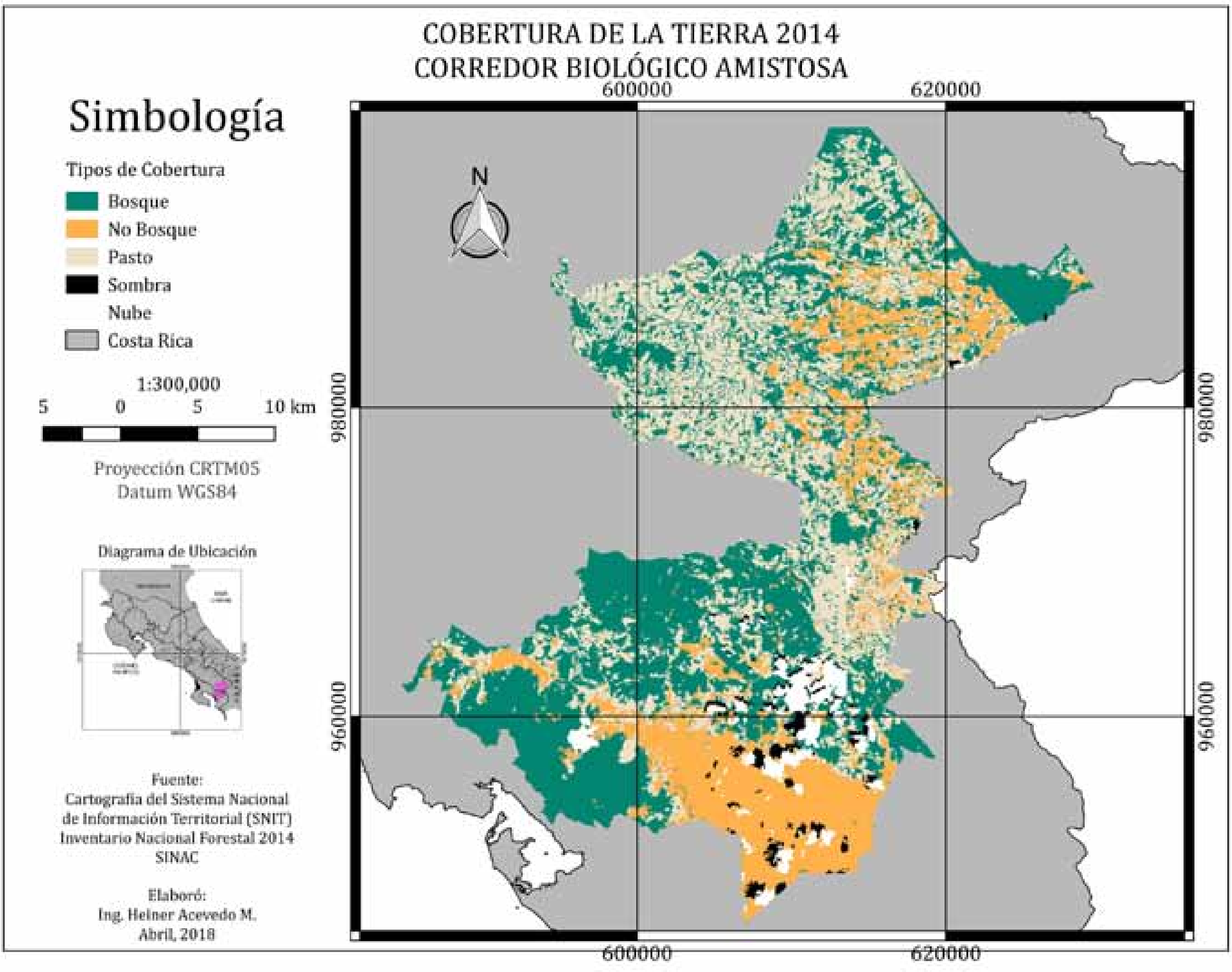
Due to various economic, social and political developments, massive deforestation has taken place in the tropics in recent decades, including in Meso-America and especially Costa Rica. The planting of large monocultures (oil palms, bananas, pineapples) and the emergence of extensive pastures for meat production led to the destruction of primary habitats and the fragmentation of the remaining forests.

The Fila Cruces, a 1700-meter high, forested ridge in southern Costa Rica, is part of the COBIGA Biological Corridor, which in turn is part of the Biological Corridor AMISTOSA. This corridor is connected to the protected areas Osa and Talamanca. The closed, species-rich rain forest areas, which include the Rainforest of the Austrians, were formerly interconnected. Today they are interrupted by overgrown or abandoned pastures, resulting in the isolation of primary forest areas. Remaining, isolated „forest islands“ that are surrounded by agricultural land are not viable for a long time, as a genetic exchange with plant and animal species outside protected areas is often no longer possible. This leads to a depletion of species; some species are completely eradicated. The degradation of such sites varies, depending on location and land management. Some sites can be left over to natural succession, and within a few decades a species-rich secondary forest will grow naturally.

However, severely degraded locations are characterized by a lack of seed banks, and a natural succession is only partially or not at all possible. At these sites, we are trying to reforest and restore the forest. With selected indigenous tree species, an attempt is being made to recreate a species-rich forest.

Forest cover	Area in Ha.	Area in %
Forested	39.836	43%
Not forested	19.260	21%
Cloud forest	3.038	3%
Pasture	29.386	32%
Shade	1.834	1%
TOTAL	82.904	100%

Percentage of Biological Corridor Area according to a study by the Tropical Station La Gamba, published by the Costa Rican National Park Administration in 2018

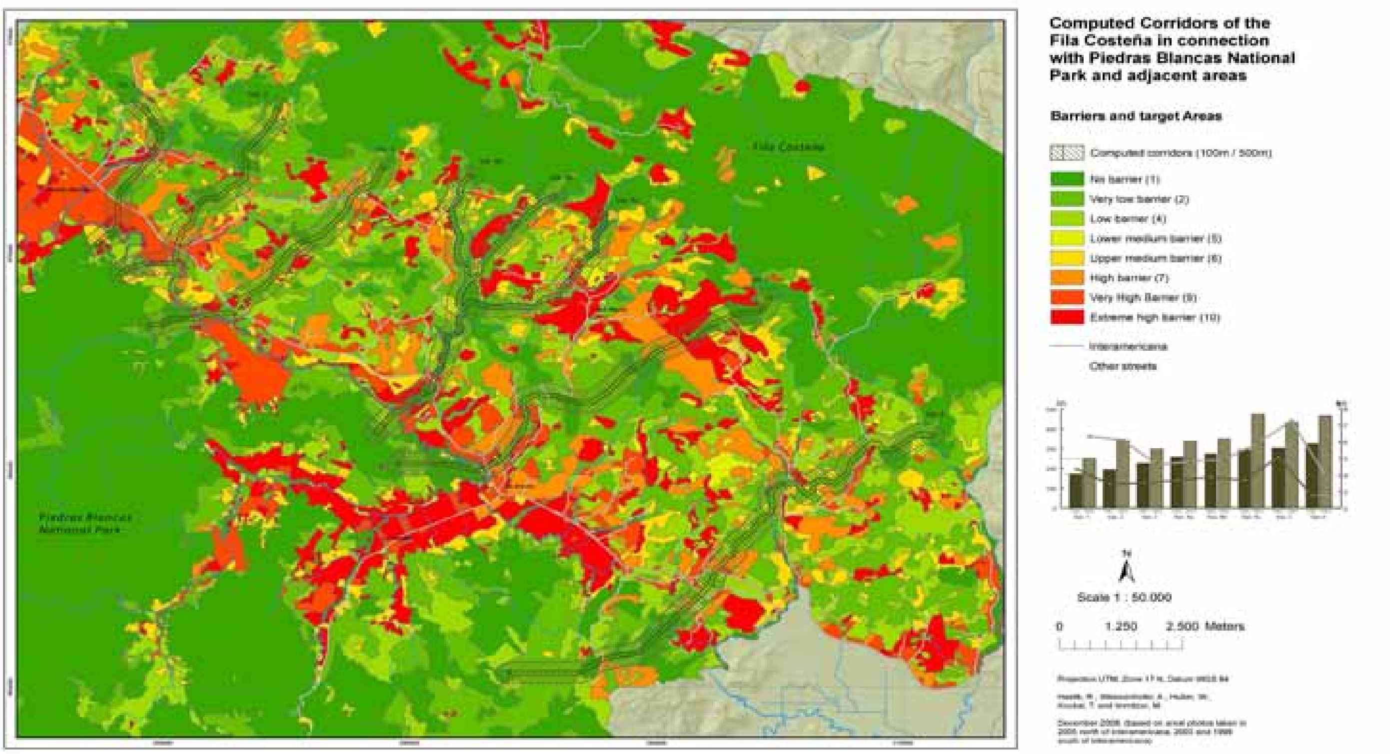


Additionality

In cooperation between the Association Rainforest of the Austrians, the Tropical Station La Gamba, the University of Vienna, the University of Natural Resources and Life Sciences, Rainforest Luxembourg, the National Park Service of Costa Rica and the regional parks Amistad and Osa, reforestations with indigenous tree species are carried out in selected areas and scientifically monitored. The aim is to facilitate migratory movements of animals and plants between isolated forest areas and to protect the source areas of some important rivers. The continuous biological corridor COBIGA has been created starting in 2009. COBIGA is part of the planned „Corredor Biológico Amistosa“ with a projected area of 920 km², which is to be created by 2027 in cooperation between the Republic of Costa Rica and several NGOs.

The purchase of land in the biological corridor allows the natural regeneration of formerly agricultural land and the emergence of new rainforests through reforestation. The project is an important contribution to climate protection. Deforested land is purchased and left to natural succession, ensuring (over a period of 60 years) an average binding of about 9.5 tons of the greenhouse gas CO_2 per hectare per year. Arable and pasture land is purchased and planted with rainforest trees, saving an average of 11.75 Kg of CO_2 per tree per year.

The COBIGA project is a relatively large-scale, cumulative project that can only be made possible through debt financing and external funding.. For years we have been trying to acquire suitable areas for the corridor in order to create a new rainforest (CO_2 sink). According to our calculations, 9.5 tons of CO_2 would be added per hectare per year. In 60 years, this would amount to 570 tons per Ha.



Calculation of carbon sequestration in reforestation in the tropics

Scientific Advice:

ao.Univ.Prof. Mag.Dr. Wolfgang Wanek (University of Vienna, Faculty Center for Ecology)
Univ.Prof. Dr. Andreas Richter (University of Vienna, Faculty Center for Ecology)
ao.Univ.Prof.Dr. Roland Albert (University of Vienna, Faculty Center for Ecology)
Univ.Prof.Dr. Konrad Fiedler (University of Vienna, Faculty Center for Biodiversity)
Dr. Werner Huber (University of Vienna, Faculty Center for Biodiversity)
Dr. Anton Weissenhofer (University of Vienna, Faculty Center for Biodiversity)
Univ.Doz.Dr. Peter Weish (University of Natural Resources and Life Sciences Vienna, Institute of Zoology)

Dry biomass: 340 tons per hectare

Dry biomass is the amount or mass of living organisms that is > 95% of trees in forests. According to various sources, the above-ground biomass of tropical rainforests in Central and South America amounts to 125-474 t OTS (organic dry matter) per hectare (Table 1). The large differences are related to location, climate, soil type and nutrient availability, the tree species composition and the calculation method. The most scientifically recognized calculation of biomass applied to the Esquinas Rainforest yields a mean (median) of 315 t OTS above ground biomass per hectare (Table 2), with a range of 233 to 447 t OTS per hectare. This value is based on 10 study sites in the Rainforest of the Austrians. To calculate the total biomass of the forest, we include an average underground biomass (roots) of 20%, thus resulting in 78 t per hectare of underground biomass in the Rainforest of the Austrians. The inclusion of the roots therefore increases the total biomass values 1.25-fold, and therefore from 315 to 394 t OTS per hectare. However, as the subterranean biomass was only collected in a few tropical studies and there are no reliable totals for the region, we assume a conservative value of 25 t OTS underground per hectare, giving a total biomass of 340 t OTS per hectare.

Carbon content: 160 tons per hectare

A new study showed that the carbon content (C) of dry wood biomass is 42-52%, with an average of 47.4% [Martin and Thomas, 2011]. We therefore assume a mean carbon content of 47.4% and assume that in the Rainforest of the Austrians (at the climax stage) 160 tonnes of carbon are bound per hectare.

Carbon dioxide equivalent: 590 tons per hectare

The factor 3.67 can be calculated from atomic weights. The atomic weight of carbon (C) is 12, of oxygen (O) 16, The molecular weight of carbon dioxide (CO_2) is 44. 12 parts by weight of carbon are contained in 44 parts by weight of carbon dioxide. Therefore, 1 part by weight of carbon corresponds to 3.67 parts by weight of CO_2. Accordingly, 161 t of carbon correspond to 591 t of CO2. Rounding out, we therefore assume 590 t of CO_2 per hectare.

Turning time: 60 years

The "Umtriebszeit" is the term for the average duration of the germination of the tree from the seed until its dying off. Although individual neotropical trees such as the kapok tree can grow up to 500 years or older, the average lifespan of trees is estimated to be 40-110 years and that of the rainforest to 50-70 years. We assume a natural turnover time of 60 years. Secondary forests reach the biomass equivalent of undisturbed forests in about 60 years. "Climatic societies", i.e. those vegetation forms which adjust after long-term undisturbed development, are in the common opinion plant communities which exhibit the maximum existence of biomass. Secondary forests reach the biomass equivalent of undisturbed rainforests in about 30-190 years. The large deviations are explained by differences in previous land use, climatic differences, and differences in soil fertility and soil texture. Secondary forests in humid tropical areas with (moderately) nutrient-rich soils have very fast recovery rates and reach the biomass equivalent of undisturbed forests in 30-60 years. We therefore assume that in this region, under comparable environmental conditions, the secondary succession is rapid and the secondary forests reach the biomass equivalent of undisturbed rainforests in 60 years.

Annual growth: ~ 10 tons of CO_2 per hectare

With a natural rotation time of 60 years, a period of approximately 60 years is required until secondary forests reach the biomass equivalent of undisturbed rainforests (here: 340 t OTS per hectare) and consequently a CO_2 equivalent of 590 t per hectare. Thus, the average annual binding over this period is 9.83 or, rounded off, ~ 10 t CO2 per hectare or 2.7 t C per hectare and year.

CO_2 storage per tree: 12.3 kg per year

Former pastureland in La Gamba and the surrounding area are being reforested with 800 young plants per hectare from 40-50 tree species. This figure already accounts for a mortality of 25-30%. The assumed CO_2 binding of 590 t / ha, divided by 800 trees, results in CO_2storage of ~ 740 kg per tree over a lifetime of 60 years or an average annual CO_2 binding of 12.3 kg per tree.

Universität für Bodenkultur Wien

University of Natural Resources and Life Sciences, Vienna

Calculation of the carbon binding of reforestation in the region of the Esquinas Rainforest, Costa Rica

Scientific Advice:
ao.Univ.Prof. Mag.Dr. Wolfgang Wanek
(University of Vienna, Faculty Center for Ecology, Department for Microbiology and Ecosystem Research)
Univ.Prof.Dr. Peter Hietz
(University of Natural Resources and Life Sciences Vienna, Department of Integrative Biology, Institute of Botany)
Dr. Werner Huber
(University of Vienna, Faculty Center for Biodiversity, Department of Tropical Ecology and Biodiversity of Animals)
Dr. Anton Weissenhofer
(University of Vienna, Faculty Center for Biodiversity, Department of Tropical Ecology and Biodiversity of Animals)

Summary: At a planting density of 800 trees per hectare and 40-50 tree species, the average annual binding of CO 2 per tree is 11.4 kg. Over a project period of 30 years, the reforestation results in the binding of 274 t CO 2 / ha or 9.1 t CO_2 per hectare per year.

In photosynthesis, plants remove CO_2 from the atmosphere, which helps to break down dead plants. CO_2 is then released again. When the biomass of plants in an ecosystem increases overall, CO_2 is absorbed as long as the biomass is retained. The reforestation of forest-free areas by creating forests with high biomass is therefore an issue. The potential carbon sink is particularly high in tropical rainforests, as the trees grow fast and the forests reach high biomass densities. To calculate the binding of carbon, data on growth rates of trees and biomass accumulation of trees must be taken into consideration. For reforestation projects in the Biological Corridor La Gamba (COBIGA) at the Costa Rica's southwestern Pacific side, we use biomass data from forests of the Golfo Dulce region and from other areas of Central America.

Biomass of the forest

Dry biomass refers to the amount or mass of living organisms that live in forests comprising at least > 95% of trees. According to various sources, the above-ground biomass of tropical rainforests in Central and South America contains 125-474 t of organic dry matter (OTS) per hectare. The big discrepancies depend on the location, climate, soil type and nutrient availability, the tree species composition and the calculation method. Virtually all biomass calculations use the relationship between tree size and weight, which was determined in many individual studies. In the simplest case, only the breast height diameter and the mean wood density of a region are used. More accurate estimates can be obtained using diameter, tree height and wood density of the individual species. For the region of the Esquinas Rainforest and Golfo Dulce, detailed studies of tree heights and tree diameter were made in twelve primary forests and in four 20-25-year-old secondary forests. Secondary forests demonstrate the intermediate stages of natural succession in abandoned pastures. According to one formula used in most studies [Chave et al., 2005] and relying on literature with known data on wood density, the biomass for all trees >10 cm in diameter was calculated. This produced an average of 254 t OTS / ha for primary forest trees and 162 t OTS / ha for secondary forest trees of >10 cm in diameter. This corresponds to a biomass build-up in secondary forests (after about 25 years succession) of about 63% of the biomass of primary forests, which coincides with literature data ([Letcher and Chazdon , 2009]). The biomass of the secondary forests in the region also corresponds to data from six 21-30 year-old secondary forests (165 t OTS / ha; [Letcher andChazdon , 2009; Mascaro et al., 2012]).

Reforestation in the COBIGA project

Reforestation aims to restore a rainforest that is as species-rich as possible, and not one in which biomass is built as quickly as possible. Therefore, species are also planted that grow much slower than typical species of secondary forests. We therefore reckon with a biomass accumulation that is somewhat slower during the first years than the biomass accumulation natural forests, and conservatively estimate that the reforestation areas will reach a biomass after 30 years that is similar to the biomass reached in secondary forests after 25 years. As biomass and growth rates of forests decrease together with altitude levels, and since our existing biomass data comes from lowland rainforests, we calculate a 10% lower biomass accumulation for our reforestation areas situated at approx. 450 m above sea level. Calculated on the total biomass of the forest, the underground biomass (roots) for tropical rainforests averages about 23.5% (22 - 32.7%, 10 studies) of the aboveground biomass [Mokany et al. , 2003]. We take here a root biomass of 20% of the aboveground tree biomass. Changes in carbon content of soil were not taken into account, because these are not necessarily lower in agricultural areas (pastures) than in forests. There are no reliable estimates of possible change of soil carbon in secondary forests in the region. Overall, the estimate gives a total biomass increase (in new reforestation areas in the sub-montane range) of 175 t biomass in 30 years.

CO_2 capture

The carbon content (C) of dry wood biomass of tropical trees is 42-52%, with a mean value of 47.4% ([2009]), resulting in a binding of 82.9 t C / ha. Because carbon dioxide consists of 12/44 parts of carbon by weight, this corresponds to a CO_2 binding of 304 t CO_2 / ha over 30 years.

Leaching, risk, CO_2 emissions through reforestation

CO_2 binding on one site can cause direct or indirect emissions elsewhere, therefore this should be included as much as possible in CO_2 compensation calculations. Leaching is understood to be when a CO_2 sink in one place causes an increased release of CO_2 of elsewhere. An example is when a pasture is reforested and elsewhere forests are cleared to create new agricultural land. Leaching effects are basically difficult to estimate. In Costa Rica, primary forests are protected and the clearing of primary forests to make way for the reforestation of old pastures is virtually ruled out. CO_2 bound in forests can be re-emitted very quickly. Risk factors can be fires, pests, wood removal or even clearcutting in the absence of control. Forest fires pose no danger in the climate of La Gamba. Pests usually only attack single tree species and the mortality of individual trees is included in the biomass development of secondary forests. The danger of uncontrolled clear-cutting is classified as very low. The area is privately owned, the legal protection of property rights in Costa Rica is good and the general social willingness to protect forests is high. Direct CO_2 emissions in connection with reforestation are mainly due to fossil fuels fuels (gasoline for transport and for equipment) and nitrogen fertilization of young trees and seedlings. These factors are difficult to estimate, but most likely of little effect. Therefore assume that direct and indirect emissions related to the reforestation are no more than 10% of the bound CO_2.

Finca Amable 2009

Finca Amable 2018

Calculation of additionality and CO_2 binding

As reference, we use the studies “Calculation of carbon sequestration in the tropics” (University of Vienna) and “Calculation of the carbon binding of reforestation in the region of the Esquinas Rainforest, Costa Rica” (University of Natural Resources and Applied Life Sciences, Vienna). The studies follow on pages 5 to 7. We assume a natural rotation time (life expectancy of a tree) of 60 years.

CO_2 binding per hectare and year with natural succession

University of Vienna 9.83 t / Ha
University of Natural Resources 9.10 t / Ha

We assume an average of 9.50 t / Ha.

CO_2 binding per tree and year in reforestation

University of Vienna 12.1 kg (yields 9.68 t / ha for 800 trees)
University of Natural Resources and Life Sciences 11.4 Kg (yields 9.12 t / Ha for 800 trees)

We assume an average of 11.75 kg / tree

It should be noted that the increase in bound CO_2 remains roughly the same for natural succession or reforestation. The suitability of land for one or the other method depends on various factors, e.g. proximity to existing forests, size of the property, soil condition. A hybrid of natural succession and reforestation can be quite useful and is already used in a project of the University of Natural Resources and Life Sciences Vienna at Finca Alexis.

The project is directed by Dr. Anton Weissenhofer and Dr. Werner Huber (directors of the Tropical Station La Gamba) and scientifically accompanied by the University of Natural Resources and Life Sciences (Prof. Dr. Peter Hietz) and the University of Vienna (Prof. Dr. Wolfgang Wanek). If desired, interim reports with photos and a final report at the end of the project will be prepared. Exact measurements of the annual increase in CO per tree or hectare on site would be extremely laborious. However, we refer to an article in NATURE 2016 and the master thesis of F. Oberleitner.

Amount of CO_2 produced by one kilowatt hour of electricity

We assume an average of 450g/kWh

Germany (Umweltbundesamt)	489g/kWh	https://www.umweltbundesamt.de/tags/strommix
United Kingdom (National Energy Foundation)	352g/kWh	http://www.carbon-calculator.org.uk/
European Union (28 countries) European Environment Agency	226g/kWh	https://www.eea.europa.eu/data-and-maps/indicators/overview-of-the-electricity-production-2/assessment
United States Environmental Protection Agency	744g/kWh	https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Amount of CO_2 produced by driving one kilometer

We assume an average of 150g per kilometer

European Market Vehicle Statistics	118g	https://www.theicct.org/sites/default/files/publications/ICCT_Pocketbook_2017_Web.pdf
United States Environmental Protection Agency	252g	https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle
European Environmental Agency	119.5g	https://www.eea.europa.eu/highlights/co2-emissions-from-cars-and
European Automobile Manufacturers Association	118.5g	https://www.acea.be/statistics/article/new-car-co2-emissions

Example: Based on utility bills, a hotel consumes 30.000 kWh per year. 30.000 x 450g = 13.500kg/11,75 kg = 1.148.
1.148 trees must be planted to balance the hotel’s CO2 emissions. If one tree costs $20, total cost is $22,960.
The hotel’s vehicles drive 20.000 km per year. 20.000 x 150g = 3.000kg./11,75 kg = 255.
255 trees must be planted to balance the vehicle’s CO_2 emissions. If one tree costs $20, total cost is $5.100.
Since the trees grow and bind CO_2 from their first year for a life span of 30-60 years, the hotel and vehicles stay carbon neutral for 30-60 years. Yearly adaptions can be made depending on kilowatt hours and gasoline consumption.

Criteria for the recognition of CO_2 climate protection projects

In voluntary emissions trading, there are a large number of individual compensation and test procedures as well as several standards which partly compete with each other. These include e.g. the Gold Standard for Sustainable Energy Compensation Projects; the more process-oriented Voluntary Carbon Standard for Enterprises or the Climate, Community and Biodiversity Standards for (sustainable) sink projects. Some companies are also following the Clean Development Mechanism (CDM) for the United Nations Framework Convention on Climate Change (UNFCCC) regulated market under the Kyoto Protocol.

The most significant and rigorous standards (Kyoto Protocol Mechanisms) are set by the UNFCC These mostly very large projects are submitted by governments or large companies and include biogas, hydropower, wind and solar energy, etc. The criteria for reaching the standards are extremely bureaucratic and laborious , A distinction must be made between standards that are strongly geared to the CDM criteria and guidelines in terms of their methodology and marketing strategy, and in part seek future recognition in the compliance market (VCS, CFS, VER + and Plan Vivo) and standards that do not meet this requirement but certify projects relevant to climate protection, but do not generate tradable certificates in analogy to the compliance market (CCBS and PRIMAKLIMA).

All projects targeting official emissions trading require external assessors and auditors, as well as detailed information such as sustainability study, environmental impact study, social study of surrounding communities, host confirmation, biomass calculations, CO2 calculations, satellite imagery, exact maps, list of tree species, Baseline and Leakage Calculations. The project document for a 172-hectare sustainability and reforestation project in Uganda alone is 326 pages long. The COBIGA project could only be submitted as a CCBS, VCS-REDD or VER if a large company were to finance it to officially neutralize its emissions. The stricter the criteria of a certification, the bigger the project has to be because otherwise the preparation work will not pay off. For examble, prevalidation and validation of a project involving the planting of 60,000 trees on 75 hectares would require an external auditor and cost at least € 20,000. If an assessment is carried out by an international NGO, it could take a few years and cost more than € 100,000.

So far, our sponsors (Raiffeisen Leasing, Austrian Post, Bank Austria, Wüstenrot, OMV, ÖBB Infrastruktur) have participated in our projects in good faith and accepted the calculations made by the University of Vienna and the University of Natural Resources and Life Sciences. However, we can not issue emission certificates or certificates because our projects are neither officially registered nor recognized. We will be happy to provide our own list of criteria and to provide the donor with detailed scientific documentation, photos, videos, detailed accounts, bookkeeping, etc. Since our projects take place only in the area of La Gamba, they can easily be visited by potential sponsors.

Rainforest of the Austrians/Tropical Station La Gamba
Land purchase in the biological corridor COBIGA 2009-2018

Property	Area in Ha.	Price in Euro	Price per Ha.
Finca Hermenegildo	14,72	32.000	2.174
Finca Alexis 1	76,25	308.000	4.039
Finca Alexis 2	16,87	51.000	3.023
Finca Julian	54,29	123.000	2.266
Finca Quebrada Chorro*	100,98	0	0
Finca Ovelio	16,54	62.000	3.748
Finca Amable	14,63	107.000	7.314
Finca Alexis 3	41,90	N.N.	N.N.

*Finca Quebrada Chorro was donated by sponsors in Austria

Reforestation

- The Tropical Station La Gamba takes over the planning, administration and scientific support. Scientific support requires a preparatory phase. With the help of on-site technical assistance, forest engineers are employed to calculate the location and size of the areas and the amount of plant material needed. Courses are held by the tropical station, especially regarding nursery, efficient handling of seedlings and care of young trees.

- From seeds of about 40-80 tree species from the surrounding rainforest, the young plants are grown in nurseries and greenhouses. Plant material is continuously collected for a whole year depending on the maturity of the fruit. The production of the plant material, the planting itself as well as the care of the young trees are carried out by locals under the direction of a forest engineer, which creates jobs and additional sources of income (especially during fruit ripening in the dry season from January / February to April)

- The terrain is prepared, marked and dug up. An average of 800 trees are planted per hectare. This amount is to be produced in the nursery of the tropical station La Gamba as well as by locals from La Gamba and San Miguel. The planting is only possible during the rainy season from April to November.

- After 3-5 months, the first seedlings can be planted. After 2-3 months, the replanting of possibly dead young trees and the care of the seedlings begins. These must be free from lianas and grasses growing on the plantation. In the first 2-3 years, such a care measure is necessary every 2-3 months.

- Local workers and Austrian volunteers look after the young forests for more than three years (clearing, fertilization, repositioning of dead trees). After 3 years, the trees should be strengthened and get along without further care. Checks if necessary should nevertheless be made twice a year. Through continuous monitoring of the plantations, scientific knowledge should be gained on growth rates, efficiency of CO_2-binding, repopulation strategies, suitability of tree species and conservation of biodiversity.

- The goal is to reproduce with native species. In general, forestry in the tropics has generally focused on a few fast-growing tree species that come from Africa or Asia. The best known species are melina and teak. For biological corridors, however, such species are of little value, since they hardly provide food for other animals. Therefore, it was searched for suitable indigenous trees of biological value (e.g., fodder plant for wild animals). To date, a list of about 60 suitable tree species has been compiled, which is constantly updated.

Finca Carlos Monge (completed)

The 21.87 Ha. large Finca Carlos Monge in the Bonito Valley was purchased in 2009, incorporated into the National Park and completely left to natural regeneration. The purchase price was CRC 50,279,829 (approximately EUR 75,000). Former livestock pasture with farm converted into a species-rich young forest by natural regeneration,which was favored in its growth by the immediate vicinity of the national park. Reforestation did not take place.

Finca Carlos Monge 2009

Jaguar, photographed near Finca Carlos Monge 2010

Bonito valley with Finca Carlos Monge (right)

Finca Carlos Monge 2014

Finca Amable, La Gamba (completed)

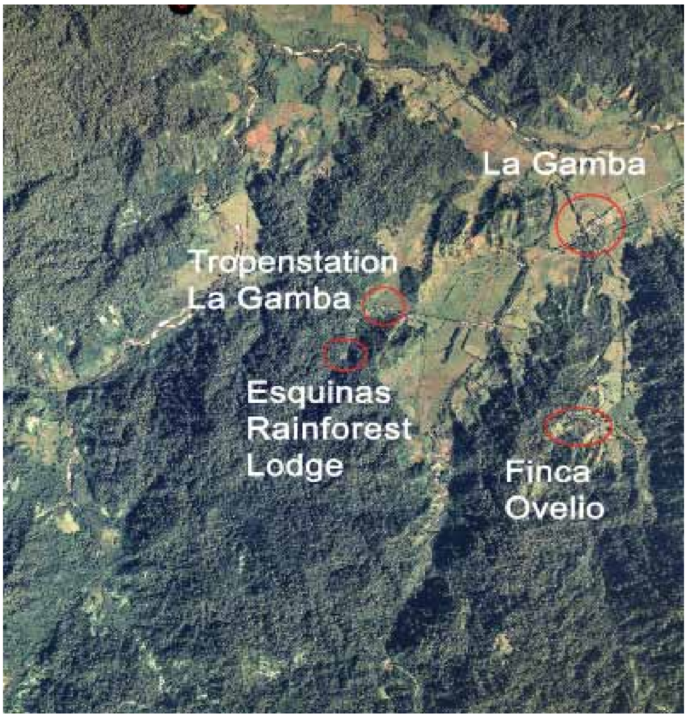
As Finca Amable was a completely cleared field, a 100% reforestation of 10,700 trees from 190 tree species was carried out here on an area of 12 hectares. Mortality was 17.5%. The project was entirely financed by the Rainforest of Austrians. The reforestation cost € 153,000, the purchase price for the land was € 107,000. The costs per tree including land purchase amounted to 24 euros.

Final report Finca Amable,
PDF 41 pages (Spanish).

Finca Amable
Left: satellite photo 2009
Above: aerial photo after 2 years reforestation

Finca Amable

Above right: new forest 2014
Above left: this gallinazo tree reac hed a height of 5m after 2 years.
Right: volunteers planting trees



Finca Ovelio, La Bolsa, La Gamba (completed)

In this project, which was implemented between 2010 and 2012, 50% of the total area was reforested with 6,065 trees from 113 species. The mortality was 10%. The remaining 50% was left to natural succession. The project was entirely financed by the NGO Rainforest of the Austrians. The costs for reforestation amounted to EUR 60,000, the purchase price for the land was € 62,631. The assumed binding of CO_2 is 5,550 tons over a period of 60 years. The cost of a ton of CO_2 was therefore 22 euros.

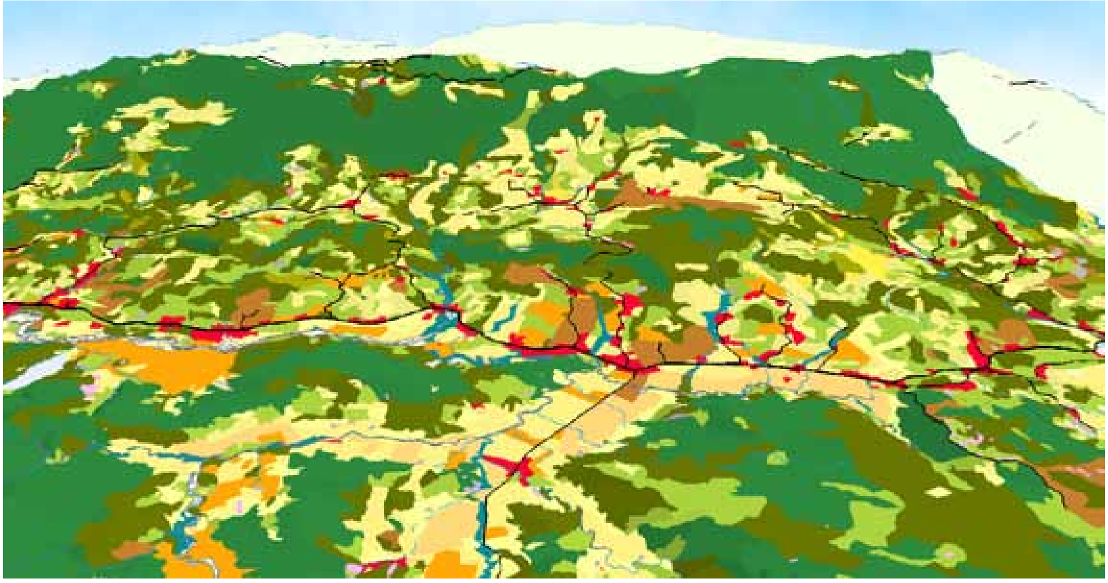
Final report Finca Ovelio,
PDF 43 pages (Spanish).

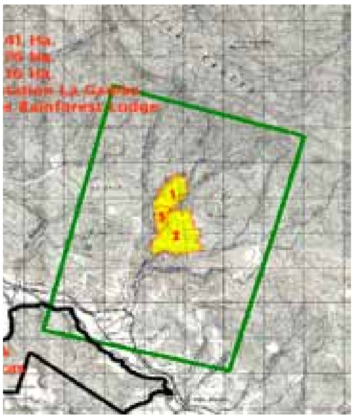







Graphic view of the Fila Cruces. The Fincas Alexis are in the middle of the picture. The Biological Corridor COBIGA is to connect the forests of the Fila Cruces with the Esquinas Rainforest.





Karte und Satellitenfoto der Fincas Alexis 1, 2, 3

Finca Alexis, San Miguel (partly completed)

Finca Alexis 1

The University of Natural Resources and Applied Life Sciences has been carrying out a reforestation project at Finca Alexis since 2016. On an area of 14.6 ha, in 30 years 4,388 t of CO_2 will be withdrawn from the earth's atmosphere. The project costs € 136,209, so one ton of CO_2 costs € 31. The 76.25 hectare property was previously purchased by the NGO Rainforest of the Austrians. The aliquot price for 14.6 hectares was approximately € 62,000. Therefore, a ton of CO_2 in total about 45 euros.

Finca Alexis 2

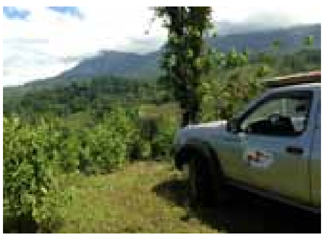
Finca Alexis 2 covers an area of 16.87 hectares and was acquired in 2016 by La Gamba Tropical Station. The financing was provided by the association Rainforest of the Austrians, the purchase price was 35 million CRC (about 51,000 euros). The property borders the Rio Esquinas and consists of primary forest, secondary forest and cleared meadows.

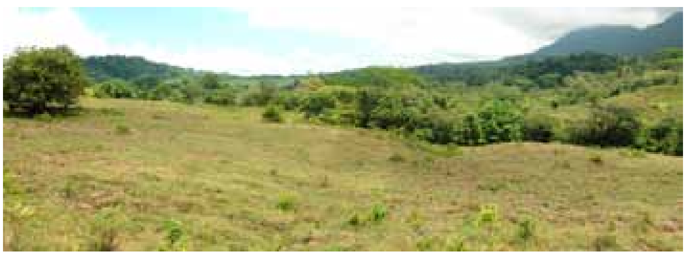
Finca Alexis 3

Finca Alexis 3 has an area of 41.9 hectares and consists of primary forest, secondary forest and farmland. The Ministry of the Environment of Luxembourg has approved a reforestation project entitled "COBIGA - Intelligent and ecological CO2 Sequestration and Creation of a Biological Corridor in the Golfo Dulce Region with reforestation, forest protection and permaculture", project volume Euro 299.603, -, duration: 3 years. The project involves promotion of scientific studies, land purchase, reforestation with 2,000 trees, purchase of 15 camera traps for a monitoring project, training / further education courses, interpretation path and roof renovation of the nursery Finca Modelo.

Above: reforestation areas on Finca Alexis 1

Below: At the Finca Alexis 1, in the background Fincas Alexis 2 and 3.
Middle: Alexis Zamora and Michael Schnitzler.





Further reforestation by the Tropical station La Gamba 2007-2010

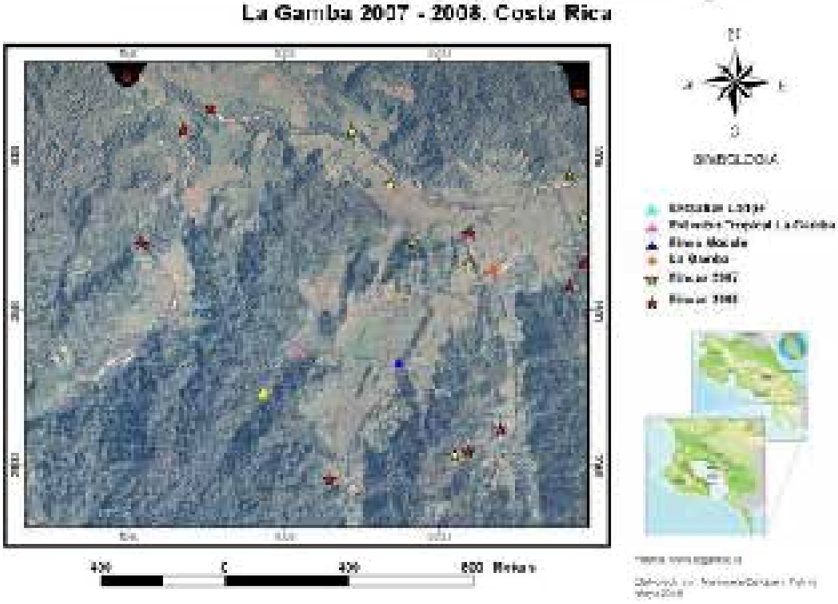
In La Gamba (about 500 inhabitants, average annual temperature: 27.4, rainy days per year: 286, rainfall per year: 5800 mm), large banana plantations were created in the 1950s. After a few years, the United Fruit Company left the area and the banana groves were replaced by cattle pastures and paddy fields. Since the African oil palm (Elaeis guineensis) has gained in economic importance, more and more farmers have planted their fields and pastures with oil palms that grow fast in the tropics and produce fruit stands of up to 50 kg. The income from the sale of palm fruits is much higher than the income from rice or livestock.

In order to prevent the last remaining pastures in La Gamba from becoming a victim of the monoculture oil palm, the Tropical station La Gamba carried out reforestation projects in small areas in 2007 and 2008 with the financial support of OMV. Planting "live fences" on riverbanks was a priority because they are favored by animals as trails and prevent erosion. Together with Finca Ovelio, more than 17,000 trees were planted in La Gamba and the surrounding area. Tropical Station biologists experience in La Gamba and the surrounding area.

2007					
Finca	Besitzer	Wiederbewaldung ha	Waldschutz ha	Anzahl Bäume	Typus
F1	Ernesto Arellan	0,8	80	210	Artenanreicherung
F2	Canuto Villegas	2,2	1	1087	Flußbegrünung
F3	Maria E Reyes	0,182		230	Flußbegrünung
F4	Brines Ramirez	0,1	0,5	50	Anreicherung
F5	Efrain Villeloro Camacho	0,2	4	340	Flußbegrünung
F6	José Angel	1		800	Flußbegrünung
F7	Ovidio Cruz	0,2		440	Flußbegrünung
F8	Richard Weider	0,1		223	Flußbegrünung
F9	Virginia Barahona	0,01		37	Wiederbewaldung regulär
F10	Arturo Quiros	1,5		600	Flußbegrünung
	Gesamt	6,272	85,5	4117	

2008					
Finca	Besitzer	Fläche Wiederbewaldung	Fläche Waldschutz	Anzahl Bäume	Typus
F11	Gerardo Chacon	160 m		110	Lebende Zäune
F12	Luis Sanchez	300 m		130	Lebende Zäune
F13	Manuel Marchena	800 m2		200	Flußbegrünung
F14	Luis Jimenez	Por definir		200	Artenanreicherung
F15	Teofilo Vargas Leon	4 ha		2500	Flußbegrünung
F16	Jose y Carlos Ortiz	1000 m2		100	Flußbegrünung
F17	Ana Maria Quiros	1500 m2		200	Flußbegrünung
F18	Werner Klar	1500 m2		200	Artenanreicherung
F19	Mari Sanchez	3 ha		2000	Wiederbewaldung regulär
	Gesamt	ca. 8-9ha		5640	

Ubicación de fincas dentro del proyecto Corredor Biológico
La Gamba 2007 - 2008. Costa Rica



List of tree species used in previous reforestations in La Gamba

Photos: Nurseries in La Gamba, Rio Claro and San Miguel, created for the reforestation projects 2007-2010

Nr.	Family	Genus	species	Vernacular name	Status
1	Anacardiaceae	*Anacardium*	*excelsum*	Espavel	common
2	Anacardiaceae	*Astronium*	*graveolens*	Ron ron	extincion
3	Anacardiaceae	*Spondias*	*mombin*	Jobo	common
4	Apocynaceae	*Aspidosperma*	*myristicifolium*	cara tigre	amenazada
5	Apocynaceae	*Aspidosperma*	*spruceanum*	Manglillo	common
6	Bignoniaceae	*Tabebuia*	*guayacan*	Corteza	extincion
7	Malvaceae	*Bursera*	*simarouba*	Indio desnudo	common
8	Bombacaceae	*Ceiba*	*pentandra*	Ceiba	amenazada
9	Bombacaceae	*Ochroma*	*pyramidale*	Balso	common
10	Fabaceae-Casalpinioideae	*Schizolobium*	*parahyba*	Gallinazo	common
11	Fabaceae-Casalpinioideae	*Copaifera*	*camibar*	Camibar	extincion
12	Fabaceae-Casalpinioideae	*Cynometra*	*hemitomophylla*	Cativo, guapinol negro	extincion
13	Fabaceae-Casalpinioideae	*Peltogyne*	*purpurea*	Nazareno	amenazada
14	Clusiaceae	*Calophyllum*	*brasiliense*	Maria	common
15	Combretaceae	*Terminalia*	*amazonica*	Amarillon	common
16	Euphorbiaceae	*Hyeronima*	*alchorneoides*	Pilon, zapatero	common
17	Euphorbiaceae	*Acalypha*	*diversifolia*	Gusanillo, rabo de gato	common
18	Euphorbiaceae	*Croton*	*schiedeanus*	Colpachí	common
19	Fabaceae	*Platymiscium*	*curuense*	Cristobal, Cachimbo	extincion
20	Fabaceae	*Dussia*	*discolor*	Sangregao, targuayugo	extincion
21	Salicaceae	*Tetrathylacium*	*macrophyllum*	Lengua de vaca, zapote	common
22	Humiriaceae	*Humiriastrum*	*diguense*	Chiricano alegre, lorito, nispero	extincion
23	Lauraceae	*Ocotea*	sp.	Ira	common
24	Lecythidaceae	*Couratari*	*guianensis*	Copo hediondo	extincion
25	Lecythidaceae	*Lecythis*	*ampla*	Jicaro, olla de mono	extincion
26	Meliacae	*Carapa*	*guianensis*	Cedro bateo	common
27	Meliaceae	*Cedrela*	*odorata*	Cedro amargo	common
28	Meliaceae	*Guarea*	*grandifolia*	Caobilla	common
29	Fabaceae/Mimosoideae	*Inga*	*oerstedtiana*	Cuajiniquil	common
30	Fabaceae/Mimosoideae	*Inga*	spp.	Guaba	common
31	Fabaceae/ Mimosoideae	*Parkia*	*pendula*	Tamarindo, tamarindo gigante	extincion
32	Fabaceae/Mimosoideae	*Zygia*	*longifolia*	Sotocaballo	common
33	Moraceae	*Brosimum*	*utile*	Lechoso	common
34	Moraceae	*Artocarpus*	*altilis*	Castaño, fruto de pan	no nativo
35	Moraceae	*Brosimum*	*alicastrum*	Ojoche	common
36	Moraceae	*Ficus*	*insipida*	Chilamate	common
37	Myristicaceae	*Virola*	*koschnyi*	Fruta dorada	common
38	Olacaceae	*Chaunochiton*	*kappleri*	Manglillo	extincion
39	Olacaceae	*Minquartia*	*guianensis*	Manu, manu negro, palo de piedra	extincion
40	Poaceae	*Gynerium*	*sagittatum*	Caña brava	common
41	Malvaceae	*Apeiba*	*membranacea*	Peine de mico	common
42	Malvaceae	*Apeiba*	*tibourbou*	Peine de mico	common
43	Malvaceae	*Luehea*	*semanii*	Guacimo colorado	common
44	Malvaceae	*Mortoniodendron*	*anisophyllum*	Cuero de vieja	common
45	Verbenaceae	*Vitex*	*cooperi*	Manu platano	common
46	Vochysiaceae	*Qualea*	*paraensis*	Masicaran	extincion
47	Vochysiaceae	*Vochysia*	*ferruginea*	Mayo	common
48	Vochysiaceae	*Vochysia*	*alleniii*	Mayo	common

Calculation of costs for reforestation

For the calculation of a ton price of CO_2 several factors are decisive:
• Share of pasture per property purchased
• Size of reforestation area per property purchased
• Number of trees planted
• Cost of the basic purchase
• Costs for reforestation

As these numbers change from project to project, it is impossible to set a fixed, permanent CO_2 price per hectare. Ton prices for CO_2 range from € 6 (purchase of existing forest) to € 45 (purchase of pasture land plus its reforestation with 800 trees per hectare). Those properties in the Biological Corridor that have been purchased cost between 2200 and 7000 euros per hectare. We endeavor to set the upper limit at 6,000 Euro / Ha.; therefore, a (fictitious) price of 60 cents per square meter is listed on our website. Some landowners still demand utopian prices of up to 20,000 euros per hectare, and it takes tough negotiations to reduce the price to an acceptable level.

The studies by the Univ. Vienna and the BOKU Vienna, as well as the actual expenditures for the previous reforestation projects have allowed us to extrapolate the CO_2-binding and the costs of a single, planted rainforest tree. The cost of 18 euros per tree is made up of

- Chemical soil tests
- Preparing and leveling the terrain
- Draining, building drainage ditches
- Collecting seeds and young plants
- Maintenance of the Finca Modelo nursery in La Gamba
- Growing young plants in greenhouses
- Production of compost earth with worm compost
- Marking and setting the young plants
- Fertilizer
- Care of the young trees over a period three years
- Elimination and replacement of dead plants
- Salary and food of a forest engineer
- Salaries and food for the laborers
- Catering for volunteers
- Scientific support by the Tropical Station La Gamba
- Construction of fences, bridges, sheds
- Appliances, building materials, hardware
- Transport costs (pick-up), gasoline
- Insurance of laborers and car
- Training for employees
- Accounting Costa Rica and Vienna

Two year old trees on Finca Amable in La Gamba

Tropical Station La Gamba
Verein zur Förderung der Tropenstation La Gamba
Rennweg 14
A-1030 Wien
tropenstation.botanik@univie.ac.at

Rainforest of the Austrians
Verein Regenwald der Österreicher
Veilchenweg
A-62301 Groß-Enzersdorf
info@regenwald.at

Responsible for content:
Univ. Prof. Michael Schnitzler
golfito1@icloud.com

Links

Final report Finca Amable, PDF 41 S (Spanish).
Final report Finca Ovelio, PDF 43 S (Spanish).

Growth and survival of rainforest seedlings in reforestation in lowland Costa Rica

Creating a forest: Trees for biological corridors in the Golfo Dulce region, Costa Rica

Öko-L 38/3: Der Biologische Korridor COBIGA in La Gamba

Master and bachelor thesis in connection with COBIGA

Eletzhofer S. Anpassung an Lichtverhältnisse bei tropischen Baumarten in einem Wiederbewaldungsprojeket in Costa Rica. Masterarbeit BOKU Wien.

Kleinschmidt S. 2017. Growth performance of native tree species planted on abandoned pastures in humid tropical lowland of Costa Rica, Central America. Univ. Wien. BOKU Wien. Masterarbeit.

Mala B. 2017. Tree growth and carbon sequestration of a reforestation trial in La Gamba, Costa Rica. Diplomarbeit. BOKU Wien.

Feldmeier S. Tree growth and survival in a tropical reforestacion in Costa Rica. Univ. Wien & BOKU Wien. Masterarbeit.

Riedl I. 2017. Gallery forests in the lowland of Costa Rica: Ecological traps or suitable breeding sites and dispersal corridors for forest birds? Univ. Wien. Dissertation

Oberleitner F. 2016. Plant species, diversity, functional diversity and natural regeneration within secondary rainforests in the Golfo Dulce Region in SW Costa Rica. Univ. Wien. Masterarbeit..